TITLE

POWER PLANT

FIELD OF THE INVENTION

5   - The present invention relates to a power plant wherein permanent magnets and electromagnets are combined with each other so as to obtain an increased rotational energy.

BACKGROUND OF THE INVENTION

10   Inventions wherein permanent magnets and electromagnets are combined with each other to thereby constitute a power plant in an attempt to obtain an output greater than an input power have been proposed

15   (see, for example, Japanese Patent Application Laid-open Specification No. 7(1995)-87725).

However, for example, the power plant disclosed in the above Japanese Patent Application Laid-open Specification No. 7(1995)-87725 has a complex

20   constitution including not only permanent magnets and electromagnets but also, for example, a rotary balancer. Further, this power plant has a drawback in that it is not so constituted as to utilize the torque of a rotor with the result that any desirable energy efficiency

25   cannot necessarily be attained.

OBJECT OF THE INVENTION

The present invention has been made in view of the above state of the prior art. Specifically, it is an

5   object of the present invention to provide a power plant which has a simple constitution and enables taking out a rotational energy greater than an input energy with high efficiency in accordance with the demand for resource saving and energy saving.

10   The foregoing and other objects, features and advantages of the present invention will become apparent from the following detailed description and appended claims taken in connection with the accompanying drawings.

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SUMMARY OF THE INVENTION

According to the present invention, there is provided a power plant comprising:

an axle fitted with a turning force takeout part

20   and,

coaxially arranged thereon, a generator capable of outputting a power and a rotor driven and rotated by an electromagnetic force imparting means, the electromagnetic force imparting means capable of

producing an electromagnetic force with the use of an input power,

wherein, with respect to the axle, a dimension of position of imparting of a rotary driving force to the rotor in the electromagnetic force imparting means is larger than a dimension of position of output power production in the generator to thereby enable takeout, from the turning force takeout part of the axle, of a rotational energy greater than an energy equivalent to an input power applied to the electromagnetic force imparting means.

The present invention is characterized in that, with respect to the axle, a dimension of position of imparting of a rotary driving force to the rotor in the electromagnetic force imparting means is larger than a dimension of position of output power production in the generator. Thus, there can be provided a power plant which utilizes the torque of rotor attributed to the dimensional difference of the two positions and which has a simple constitution and enables takeout, from the turning force takeout part of the axle, of a rotational energy greater than an input power applied to the electromagnetic force imparting means. Further, an output power greater than the input power applied to the

electromagnetic force imparting means can be taken out from the generator.

The power plant of the present invention preferably comprises:

5 ‐ an axle fitted with a turning force takeout part,

a rotor arranged in a first location of the axle, driven and rotated by an electromagnetic force imparting means and having permanent magnets in its outer periphery, the electromagnetic force imparting means

10 fitted with n electromagnets and capable of producing an electromagnetic force with the use of an input power, and

a generator fitted with a magneto coil and arranged in a second location of the axle,

15 wherein, with respect to the axle, a dimension of position of n electromagnets capable of imparting of a rotary driving force to the rotor in the electromagnetic force imparting means is larger than a dimension of position of magneto coil in the generator to thereby

20 enable takeout, from the turning force takeout part of the axle, of a rotational energy greater than an energy equivalent to an input power applied to the electromagnetic force imparting means.

This feature of the present invention enables

25 providing a power plant which utilizes the torque of

rotor attributed to the dimensional difference, with

respect to the axle, between the position of n

electromagnets and the position of magneto coil of

generator and which has a simple constitution and

5   enables takeout, from the turning force takeout part of

the axle, of a rotational energy greater than an energy

equivalent to an input power applied to the

electromagnetic force imparting means. Further, an

output power greater than the input power applied to the

10   electromagnetic force imparting means can be taken out

from the generator.

Also, the power plant of the present invention can

preferably comprise:

an axle fitted with a turning force takeout part,

15   a rotor arranged in a first location of the axle

and fitted with groups of circularly arranged n

permanent magnets, the permanent magnets composed of

combinations of N pole and S pole oppositely arranged

with a given spacing therebetween,

20   an electromagnetic force imparting means fitted

with circularly and concentrically arranged n exciting

coils interposed between the N poles and S poles of each

of the permanent magnet groups of the rotor, the n

exciting coils energized by an input power and

25   cooperating with the groups of n permanent magnets to

thereby exert such a magnetic action that a rotary driving force is produced to thereby drive and rotate the rotor, and

a generator fitted with a magneto coil and arranged in a second location of the axle,

wherein, with respect to the axle, a dimension of position of n electromagnets capable of imparting of a rotary driving force to the rotor in the electromagnetic force imparting means is larger than a dimension of position of magneto coil in the generator to thereby enable takeout, from the turning force takeout part of the axle, of a rotational energy greater than an energy equivalent to an input power applied to the electromagnetic force imparting means. In this power plant, in the rotor, the groups of n permanent magnets composed of N pole and S pole combinations are combined with the n exciting coils of the electromagnetic force imparting means in a single-stage arrangement or plural-stage arrangement.

This feature of the present invention enables providing a power plant which can employ a sandwich structure composed of the groups of n permanent magnets consisting of N pole and S pole combinations and the n exciting coils, which utilizes the torque of rotor attributed to the dimensional difference, with respect

to the axle, between the position of n electromagnets

and the position of magneto coil of generator and which

enables efficient takeout, from the turning force

takeout part of the axle, of a rotational energy greater

5   than an energy equivalent to an input power applied to

the electromagnetic force imparting means. Further, an

output power greater than the input power applied to the

electromagnetic force imparting means can be efficiently

taken out from the generator.

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BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 is a schematic sectional view of one form of

power plant according to the present invention;

Fig. 2 is a schematic top view of one form of power

15   plant according to the present invention;

Fig. 3 is an explanatory view of the first model

presented for explaining the principle of the power

plant of the present invention;

Fig. 4 is an explanatory view of the second model

20   presented for explaining the principle of the power

plant of the present invention;

Fig. 5 is an explanatory view of the third model

presented for explaining the principle of the power

plant of the present invention;

Fig. 6 is an explanatory view of the fourth model presented for explaining the principle of the power plant of the present invention;

Fig. 7 is an explanatory view of the fifth model presented for explaining the principle of the power plant of the present invention;

Fig. 8 is an explanatory view of the sixth model presented for explaining the principle of the power plant of the present invention;

Fig. 9 is a block diagram of rotational position detecting means provided in the power plant of the present invention;

Fig. 10 is a circuit diagram including a photocoupler as a representative example of the rotational position detecting means, a time constant circuit, a driving circuit having a transistor and an electromagnet according to the present invention;

Fig. 11 is a diagram of the respective driving waveforms of electromagnets according to the present invention;

Fig. 12 is a schematic top view of another form of power plant according to the present invention;

Fig. 13 is a schematic top view of a further form of power plant according to the present invention;

Fig. 14 is a schematic side view of still a further form of power plant according to the present invention;

Fig. 15 is a schematic front view of the power plant of Fig. 14;

5   . Fig. 16 is a diagram of particular respective driving waveforms of n electromagnets according to the present invention;

Fig. 17 is a diagram of other respective driving waveforms of n electromagnets according to the present

10   invention;

Fig. 18 is a schematic side view of still a further form of power plant according to the present invention;

Fig. 19 is a schematic top view of still a further form of power plant according to the present invention;

15   Fig. 20 is a schematic side view of one form of power plant having two rotors according to the present invention;

Fig. 21 is an explanatory view of a manner of mutual attraction between permanent magnet and

20   electromagnet; and

Fig. 22 is an explanatory view of a manner of mutual attraction between permanent magnet and electromagnet.

25   DETAILED DESCRIPTION OF THE INVENTION

The power plant of the present invention will be described in detail below with reference to the appended drawings.

First, referring to Figs. 3 to 8, the principle of the power plant of the present invention will be described.

In recent years, there is a demand for the development of a power plant which enables taking out a rotational energy greater than an input energy in accordance with the requirement for resource saving and energy saving.

In Fig. 3, m denotes the magnetic force (constant) of permanent magnet. H and l denote the magnetic field of electromagnet (magneto coil) and the distance between rotational center O and the permanent magnet, respectively. Further, θ denotes the angle made by the electromagnet and rotational center against the position of permanent magnet. When M, T and W represent the magnetic force of electromagnet, the torque and the workload, respectively, there exists the following relationship:

$$T = m \cdot l \cdot H \cdot \sin \theta.$$

When T = W is assumed, generally, the workload relationship is Wo $\leq$ Win, wherein Wo represents the output workload, and Win the input workload. The input

power applied to the electromagnet is attenuated by, for example, coil loss.

Referring now to Fig. 4, a model of power plant, wherein permanent magnet 2 (magnetic force energy M) is arranged in an outer periphery of rotor 1, electromagnet 12 is arranged in the vicinity of the outer periphery of rotor 1, and, further, magneto coil 22 is arranged in the vicinity of the outer periphery of rotor 1, will be considered.

When the rotor 1 is rotated by the magnetic force energy of electromagnet 12, L_1, the energy $M \times L_2$ wherein L_2 represents the magnetic force energy of magneto coil 22 is produced at the magneto coil 22 by the attractive force (or repulsive force) between permanent magnet 2 and electromagnet 12, $M \times L_1$. Thus, the relationship $(M \times L_1) = (M \times L_2)$ is established.

Because the magnetic force energy M of permanent magnet 2 is constant, the magnetic force energy of electromagnet 12, L_1, is equal to the magnetic force energy of magneto coil 22, L_2. $L_1 = L_2$.

That is, even if the relationship $(M \times L_2) > (M \times L_1)$ is intended, it becomes impossible to simultaneously utilize the permanent magnet 2 in the above model of power plant. In other words, when $(M \times L_2) > (M \times L_1)$ is to be realized, any single permanent magnet 2 cannot

be simultaneously utilized in constitutions using the same rotor 1.

Now, referring to Fig. 5, another model of power plant is considered. In this model of power plant, two rotors 1, 1' are employed. Permanent magnet 2' having magnetic force energy M' which is, for example, twice that of the above permanent magnet 2 (magnetic force energy M), M' = 2M, is arranged in an outer periphery of rotor 1'. Electromagnet 12 is arranged in the vicinity of the outer periphery of rotor 1'. Permanent magnet 2 is arranged in an outer periphery of rotor 1, and, further, magneto coil 22 is arranged in the vicinity of the outer periphery of rotor 1. In this model of power plant, the relationship $(M \times L_2) = (M / 2 \times L_2)$ is established. Thus, the relationship between the magnetic force energy of electromagnet 12, L_1, and the magnetic force energy of magneto coil 22, L_2, becomes $(L_1 < L_2)$.

However, actually, there exist influences of, for example, the frictional resistance of rotor 1, power loss and material weight, and the magnetic force of magneto coil 22 competes with the magnetic force of electromagnet 12. Therefore, it is difficult to realize the relationship: input power < output (output energy).

Referring to Fig. 6, the point of $1 \cdot \sin \theta$ from the rotational center O is referred to as A (position of magneto coil), and the point of $1' \cdot \sin \theta$ from the rotational center O is referred to as B (position of

5   electromagnet).

$1' = 2 \cdot 1$ is assumed. The energies at point A and point B are defined as mH and m'H', respectively.

Under these conditions, the generated energy at point A is expressed by the formula: $G_T = m \cdot 1 \cdot H \cdot \sin \theta$,

10   and the driving power at point B is expressed by the formula: $W_{T'} = m \cdot 1' \cdot H' \cdot \sin \theta$. Because the workloads at point A and point B are equal to each other, the relationship: $m \cdot 1 \cdot H \cdot \sin \theta = m' \cdot 1' \cdot H' \cdot \sin \theta$ is established. By introducing the relationship $1' = 2 \cdot 1$,

15   the workload at point B is expressed as $2 \cdot m' \cdot 1 \cdot H' \cdot \sin \theta$. When $m = m'$, $m \cdot 1 \cdot H \cdot \sin \theta = 2 \cdot m' \cdot 1 \cdot H' \cdot \sin \theta$. Accordingly, $1 \cdot H \cdot \sin \theta = 2 \cdot 1 \cdot H' \cdot \sin \theta$. Therefore, $H' = H/2$.

Consequently, in theory, the driving power at point

20   B, $W_{T'}$, can be smaller than the generated energy at point A, G_T. For example, $W_{T'}$ can be 1/2 of G_T.

Actually, referring to Fig. 7, the potential energies at points A and A' are different from each other (points A and A' do not lie on the same plane),

25   and also the potential energies at points B and B' are

different from each other (points B and B' do not lie on the same plane). Therefore, their workloads are different from each other.

The principle of the present invention is to,

5 referring to Fig. 8, arrange, for example, n (positive integer) electromagnets 12_1, 12_2, 12_3, ..., 12_n at angular intervals of, for example, $(\theta/2)$ in the vicinity of an outer periphery of rotor 1 and sequentially exciting the electromagnets 12_1, 12_2, 12_3, ..., 12_n so

10 that attractive force or repulsive force is produced between permanent magnet 2 and oppositely positioned one of the electromagnets 12_1, 12_2, 12_3, ..., 12_n to thereby enable rotating and driving the rotor 1 with an input power less than the output (output power) taken out from

15 the power plant.

EFFECT OF THE INVENTION

The present invention enables providing a power plant which has a simple constitution and from which a

20 rotational energy greater than an energy equivalent to an input power applied to an electromagnetic force imparting means can be taken out, which power plant includes a generator from which a power energy greater than the input power can be taken out.

Further, the present invention enables providing a
power plant which utilizes a torque of rotor brought
about by a dimensional difference between the dimension
of position of n electromagnets and the dimension of

5   position of magneto coil of generator, has a simple
constitution and can realize takeout, from a generator,
of an output energy greater than an energy equivalent to
an input power applied to an electromagnetic force
imparting means.

10   Still further, the present invention enables
providing a power plant which has a constitution having
a rotor of sandwich structure comprising n permanent
magnet groups each consisting of a combination of N pole
and S pole and n exciting coils, which can realize

15   efficient takeout, from a turning force takeout part, of
a rotational energy greater than an energy equivalent to
an input power applied to an electromagnetic force
imparting means, and which can realize efficient
takeout, from a generator, of an output energy greater

20   than an energy equivalent to an input power applied to
an electromagnetic force imparting means.

PREFERRED EMBODIMENT OF THE INVENTION

The present invention will now be described in

25   greater detail with reference to the following

Embodiments, which should not be construed as limiting the scope of the invention.

One embodiment of the present invention based on the above principle will be described with reference to

5 Figs. 1 and 2 and Figs. 9 to 11.

Power plant 30 according to one embodiment of the present invention, shown in Figs. 1 and 2, has such a structure that base 11 rotatably supports axle 13 perpendicularly erected thereon and that a lower part of

10 the axle 13 is fitted with generator 10 for taking out an output power while an upper part of the axle 13 is fitted with motor unit 20 to which an input power is fed, including disk-shaped rotor 1 fixed to the axle 13. An end portion of the axle 13 is fitted with a power

15 takeout part, for example, pulley 23.

The generator 10 comprises rotator 14 fixed to the axle 13 and, arranged round the outer periphery of the rotator 14, magneto coil 22, so that any output power generated is taken out from output terminals 15. The

20 dimension (radius of inside wall) of magneto coil 22 from the center of the axle 13 is referred to as "l".

In the motor unit 20, permanent magnets 2 (two disposed in 180° arrangement in this Embodiment) are arranged in the outer periphery of rotor 1 having its

25 center fixed to the axle 13. Also, for example, sixteen

electromagnets 12_1, 12_2, 12_3, ..., 12_{16} are arranged at

angular intervals of, for example, $(\theta/2)$, which

constitute an electromagnetic force imparting means,

round the outer periphery of rotor 1. The dimension of

5   each of the sixteen electromagnets 12_1, 12_2, 12_3, ...,

12_{16} from the center of the axle 13 is referred to as

"l'" (l < l').

Further, sixteen photocouplers PC1, PC2, PC3, ...,

PC 16 as rotational position detecting means, which

10   detect the rotational position of permanent magnets 2,

are arranged so as to face the rotor 1 in corresponding

relationship to the sixteen electromagnets 12_1, 12_2,

12_3, ..., 12_{16}.

Specifically, referring to Figs. 1 and 2, for

15   example, light emitting diode LED of photocoupler PC5 is

disposed above the passage zone of permanent magnet 2

fixed to the rotor 1. Phototransistor PTR of the

photocoupler PC5 is disposed below circular channel 16

provided in the rotor 1. The rotational position of

20   permanent magnet 2 is detected by crossing of the

optical path between the light emitting diode LED and

the phototransistor PTR caused by the rotation of the

permanent magnet 2. In conformity with the rotational

position of permanent magnet 2, the corresponding

25   electromagnet 12_5 is driven.

The arrangement of the other fifteen photocouplers PC1, PC2, PC3, ..., PC 16 is the same as that of the photocoupler PC5.

Fig. 9 is a block diagram of the above-mentioned
5 rotational position detecting means. Fig. 10 is a circuit diagram including photocoupler PC1 as a representative example of the rotational position detecting means, time constant circuit 18, driving circuit 19 having transistor TR and electromagnet 12_1
10 according to the present invention. Fig. 11 is a diagram of the respective driving waveforms of electromagnets 12_1, 12_2, 12_3, ...

Referring to Fig. 10, the time constant circuit 18 consists of a parallel circuit of condenser C1 and
15 resistor R3. Mark R1 denotes a bias resistor for the light emitting diode LED. Mark R2 denotes a bias resistor for the phototransistor PTR.

In the power plant 30 of the above constitution, the sixteen electromagnets 12_1, 12_2, 12_3, ..., 12_{16}
20 arranged in the vicinity of the outer periphery of the rotor 1 are connected to an input power source (not shown). The rotor 1 is actuated. The position of permanent magnet 2 rotated with the rotor 1 is detected by means of the photocouplers PC1, PC2, PC3, ..., PC 16.
25 The corresponding electromagnets 12_1, 12_2, 12_3, ...,

12_{16} are sequentially excited as shown in Fig. 11. As a

result, rotary driving force is imparted to the rotor 1

and the axle 13 by the attractive force or repulsive

force between the electromagnets 12_1, 12_2, 12_3, ...,

5   12_{16} and the permanent magnets 2. Thus, the rotor 1 and

the axle 13 are driven and rotated.

Accordingly, the rotator 14 of the generator 10 is

rotated together with the axle 13. Electricity is

produced by the magneto coil 22 disposed round the outer

10   periphery of the rotator 14, thereby enabling takeout of

an output power (generated energy) from the output

terminals 15.

In the use of this power plant, as apparent from

the above description of the principle of the present

15   invention and from the above relationship between the

dimension of each of the sixteen electromagnets 12_1,

12_2, 12_3, ..., 12_{16} of the power plant 30 from the

center of the axle 13, namely 1', and the dimension

(radius of inside wall) of the magneto coil 22 from the

20   center of the axle 13, namely 1, the input power to the

sixteen electromagnets 12_1, 12_2, 12_3, ..., 12_{16} can be

lower than the output power taken out from the output

terminals 15 of the generator 10. In other words, a

rotational energy greater than an energy equivalent to

25   the input power to the sixteen electromagnets 12_1, 12_2,

12_3, ..., 12_{16} can be taken out through the pulley 23 fixed to the axle 13 in conformity with the demand for resource saving and energy saving. Furthermore, power plant 30 enabling takeout of an output power greater than the input power can be realized.

The number of poles of the above electromagnet group can be arbitrary. For example, use can be made of 8, 12 or 24 poles. The rotational position detecting means is not limited to the above photocoupler, and various sensors can be employed. The energy saving can be enhanced by the use of 2-stage, 3-stage or more-stage motor units.

Now, other embodiments of the present invention will be described with reference to Figs. 12, 13, 14 and 15.

In the power plant 40 shown in Fig. 12, four permanent magnets 2 are disposed at 90° angular intervals in the outer periphery of rotor 1. Four electromagnets 12_1, 12_2, 12_3 and 12_4 which constitute an electromagnetic force imparting means and are composed of, for example, iron core 41 and coil L are arranged in the vicinity of the outer periphery of rotor 1. Axle 13 of the power plant 40 is fitted with a pulley (not shown).

In the power plant 50 shown in Fig. 13, sixteen permanent magnets 2 are disposed in the outer periphery of ring-shaped rotor 1A. Four electromagnets 12_1, 12_2, 12_3 and 12_4 which are composed of, for example, iron

5   core 41 and coil L are arranged in the vicinity of the inside wall of ring-shaped rotor 1A. Axle 13 of the power plant 50 is fitted with a pulley (not shown).

The power plant 60 shown in Figs. 14 and 15 has such a sandwich structure that electromagnet disk 64

10   fitted with six electromagnets 12_1, 12_2, 12_3, 12_4, 12_5 and 12_6 is interposed between a pair of disks 63, 63 each fitted with six permanent magnets 2, all the disks rotated round shaft 62 supported by frame 61. An end portion of the shaft 62 is fitted with pulley 23.

15   Figs. 16 and 17 are timing charts showing the driving waveforms of coils L exhibited when n electromagnets 12_1, 12_2, 12_3, ..., 12_n are used in a power plant. In the case of Fig. 16, n coils L are sequentially driven on at given time intervals. In the

20   case of Fig. 17, among the n coils L, odd-numbered coil L and even-numbered coil L are alternately driven on.

Now, for example, electromagnet 12_1 composed of iron core 41 and coil L is studied. When r represents the dimension of electromagnet 12_1 from the center of

25   the axle 13, L represents the magnetic force of

electromagnet 12_1 and M represents the magnetic force of permanent magnet 2, the force F between the electromagnet 12_1 and the permanent magnet 2 is expressed by the formula: $F = ML/r^2$. When, for example,

5   M = 140 and L = 10 (unit omitted), ML = 1400. With respect to, for example, the attractive force, since the attractive force is 1400, for attaining repulsion, it is needed to feed the electromagnet 12_1 with a power equivalent to 10.

10   Therefore, when an air core or homologous one is used as the iron core 41 of the electromagnet 12_1, the power plant can be driven with low power. When an air core is used as the iron core 41, 140 x 0, that is, the attractive force is nil in the event that electricity is

15   not passed. Thus, it is practically advantageous to appropriately regulate the amount of iron core as a constituent of the electromagnet and to employ a core homologous to an air core.

            Further other embodiments of the present invention

20   will be described with reference to Figs. 18 to 20.

            The power plant 70 shown in Figs. 18 and 19 includes, accommodated in box-shaped cage 81, axle 71 fitted with pulley 72 as a turning force takeout part in an arrangement exposed from the cage 81; rotor 73

25   arranged in an upper part, referring to Fig. 18, of the

axle 71; electromagnetic force imparting means 74 for

driving and rotating the rotor 73; and generator 80

arranged in a lower part, referring to Fig. 18, of the

axle 71, which has the same structure as that of the

5   generator 10 including rotator 14 and magneto coil 22 as

shown in Fig. 1. The rotor 73 comprises combinations of

N pole and S pole oppositely arranged with a given

spacing. The rotor 73 comprises groups 75 each

consisting of n (16 in this embodiment) permanent

1 0   magnets arranged circularly with equal spacings.

     The electromagnetic force imparting means 74

comprises circularly and concentrically arranged n

exciting coils 76 interposed between opposite N and S

poles of the permanent magnet groups 75 of the rotor 73.

1 5   The rotor 73 is driven and rotated by a rotary driving

force produced by the magnetic action between the n

exciting coils 76, energized by an input power, and the

groups 75 of n permanent magnets. The interstice

between each of N and S poles of the permanent magnet

2 0   groups 75 and the exciting coils 76 is set for, for

example, 3 mm.

     A rotational energy greater than an energy

equivalent to the input power to the electromagnetic

force imparting means 74 can be taken out from the

2 5   pulley 72 fixed to the axle 71 in accordance with the

aforementioned principle by, with respect to the axle

71, causing the dimension of position, l', of n exciting

coils 76 of electromagnetic force imparting means 74

which impart a rotary driving force to the rotor 73 to

5   be-greater than the dimension of position of magneto

coil 22 of the generator 80. In the power plant 70 of

Figs. 18 and 19, the rotor 73 has a single-stage

sandwich structure consisting of the n exciting coils 76

interposed between the permanent magnet groups 75.

10   Furthermore, referring to Fig. 20, there can be

provided power plant 90 fitted with rotor 73 composed of

two sandwich structures each comprising permanent magnet

groups 75 and n exciting coils 76.

        Now, the relationship between energy input and

15 output is studied with respect to the above power plant

70. Experimental results suggest that, referring to

Fig. 21, the attractive force (or repulsive force)

between electromagnet (exciting coil) 92 and permanent

magnet 91 per W of input is about in the range of 66 to

20 99 g in the use of permanent magnet 91 of 4500 gausses.

Therefore, at an input of 100 W, the attractive force

(or repulsive force) is about in the range of 6600 to

9900 g. When the dimension of position of magneto coil

22 of generator 80 (1) is 120 mm while the dimension of

25 position of exciting coil 76 of rotor 73 (l') is 5 times

1, i.e., 600 mm, the axle 71 can gain a torque of about 33 to 49.5 kg. In that instance, the rotational speed of the rotor 73 is in the range of about 700 to 1600 rpm.

5   · Further, because this rotor 73 has a sandwich structure of permanent magnet groups 75 and n exciting coils 76, the energy of the exciting coils 76 can be effectively utilized. Experiments suggest that the attractive force (or repulsive force) is enhanced as

10   much as about 50% by a sandwich structure of electromagnet (exciting coil) 92 interposed between a pair of permanent magnets 91, 91 as shown in Fig. 22 over the use of only one permanent magnet 91 as shown in Fig. 21. Specifically, the attractive force per W of

15   input is about 140 g in the structure of Fig. 22. On the other hand, the power plant 90 fitted with two-stage arranged rotor 73 as shown in Fig. 20 enables realizing a greater efficiency increase and enables obtaining a greater torque and a greater generated energy.

20   In the experiments, the magnetic field of permanent magnet 91 was measured by the use of a gauss meter. The torque of axle 71 and the rotational speed of rotor 73 were measured by the use of torque meter (model SS-200 manufactured by Ono Sokki K.K.) and revolution counter

(model HT-5500 manufactured by Ono Sokki K.K.),

respectively.